Stress Evolution Behavior in CoCrPt Alloy Thin Films with varying Pt Concentration

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CoCrPt alloy thin film is one of the most promising candidates for ultrahigh density magnetic recording media. One of interesting issues for an application of ferromagnetic thin film to high-density magnetic recording media is to investigate growth stress, since stress inevitably generated during thin film fabrication drastically alters magnetic properties as well as mechanical properties due to film fracture and buckling [1]. However, sufficient studies have not been addressed on *in situ* experimental investigation on stress evolution during film growth of magnetic thin film and its correlation with directly observed film growth structure. We have investigated *in situ* stress evolution of 400-Å $(Co_{82}Cr_{18})_{100-x}Pt_x$/1100-Å Ti alloy films with varying Pt concentration by means of an ultrahigh vacuum (UHV) chamber equipped with a highly sensitive optical deflection-detecting system [2]. Interestingly enough, the stress evolution patterns during the film deposition are remarkably changed with varying the Pt concentration. CoCrPt alloy films with lower Pt concentration ($6 \leq x \leq 13$) grow through compressive, tensile, and again compressive stress during film deposition, while CoCrPt alloy films with higher Pt concentration ($21 \leq x \leq 28$) develop with compressive and relaxed compressive stress without tensile stress generation. *In situ* stress-evolution behavior for 400-Å $(Co_{82}Cr_{18})_{100-x}Pt_x$/1100-Å Ti alloy films with the Pt concentrations of (a) 6, (b) 13, (c) 21, and (d) 28 at.% are demonstrated in Fig.1. Here, the positive slope corresponds to tensile stress, while the negative slope implies compressive stress. The microstructural studies at the stress transition region reveal that film growth structure plays a major role in considerable change of stress evolution pattern in CoCrPt alloy films with the increase of Pt concentration.

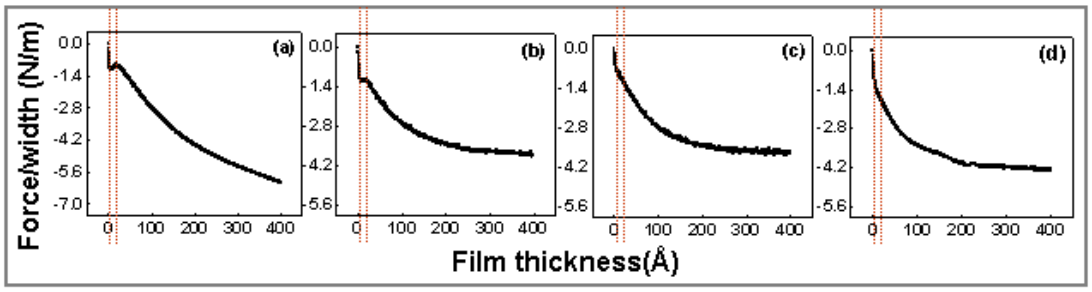

Fig.1 *In situ* stress evolution patterns as a function of film thickness in 400-Å $(Co_{82}Cr_{18})_{100-x}Pt_x$/1100-Å Ti alloy films with the Pt concentration of (a) 6, (b) 13, (c) 21, and (d) 28 at.%.

[1] G. Wedler, J. Walz, A. Greuer, and R. Koch, Phys. Rev. B 60, R11313 (1999).
[2] J.-R. Jeong and S.-C. Shin, Appl. Phys. Lett. **79**, 3296 (2001).

Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.